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Sliding-Mode Control Techniques of SEPIC Converter in Continuous Current Mode

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ABSTRACT - Nowadays, direct current (DC) voltage is required to operate machines used in many industrial applications. Photovoltaic (PV) panels generating DC voltage or other DC voltage generators need to be converted from the voltage level produced by the DC voltage levels needed to operate the machines. In order to compare the performances of the regulator used in the case of ideal and equivalent series resistance, the parameters of the gate regulator are the same.

I. INTRODUCTION

Introduction Before the advancement of modern power electronics technology, DC-DC conversion was done by operating 2 DC machines as motors and generators. The voltage value required by the load was obtained by adjusting the parameters of the DC machine working as a generator [1]. After technological advances in power electronics, these structures were replaced by DC-DC converters. DC-DC converters are circuit topologies that supply a DC voltage load below or above a desired voltage level [2]. Converters in direct current systems step up or down the voltage that is carried out by a transformer in alternating current (AC) systems [3]. While the required voltage values were adjusted using generator parameters before the technological development, now semiconductor switches are used to adjust the voltage values after the technological development. Solid state switches such as MCT, SCR, MOSFET and IGBT are generally used for power control in DCDC converters [2]. By adjusting the transfer and cut times of the switch, the desired output voltage is applied to the load side at the desired level. There are 2 different situations between the source voltage (V_{in}) and the output voltage (V_{out}) of DCDC converters. $V_{in} > V_{out}$ Buck and boost converters are considered basic converters. Some circuits use buck-boost, CUK and SEPIC converter topologies with a combination of these two basic converters. The difference between a CUK converter and a buck-boost converter and a SEPIC converter is that it has a reversed polarity between the output voltage and the input voltage

II. LITERATURE REVIEW

The upper and lower components of each stage leg cannot be simultaneously covered by reflection or EMI noise. Otherwise, overshoot will occur and damage the device. Electromagnetic interference noise (EMI) problems caused by false tripping greatly kill the reliability of the inverter. V hole inverter is resistant to waveform distortion etc. It should provide a dead time to block the upper and lower devices that will cause Compared to the current source of the inverter, the output of the LC filter must provide a sinusoidal voltage, which causes additional power loss and control complexity. [1] DC-DC converter works in 2 different time modes; Continuous Current Mode (CCM) Intermittent Current Mode (DCM) Current mode varies with inductor size. DCM occurs if the inductor current resets during power off, otherwise CCM. In general, converters are designed to run in CCM. DC to DC converters are often used in cell phone chargers, photovoltaic systems, and car audio systems. There are many studies on SEPIC converters in the literature [2]

III. EXISTING SYSTEM

- SMC is the best control system for controlling non-linear systems. The most important advantage of this method is that it does not require knowledge of the mathematical model of the nonlinear process. The concept of SMC was first proposed by Emelyanov in 1950 [18]. In the SMC method, a linear or nonlinear system is drawn and held on a defined surface in the state space using an infinitely switched feedback control [19]. This surface consists of state variables

selected according to the desired response and is called the "floating surface". Once the system reaches the slip point, its behavior becomes independent of the control of change and associated damage.

IV. PROPOSED SYSTEM

Analysis and modeling of SEPIC converter operation was done using MATLAB/SIMULINK program. In the first part of this study, floating mode and PI controller are used to achieve the best using SEPIC converter. The PI controller does not include trial and error assistance since $K_p = 0.001$ and $K_i = 0.2$. When using the PI control method, the output voltage reaches the reference value after about 0.02 seconds, while the floating type control method follows the reference value after 0.001 seconds. The output voltage error was found to be the lowest after 20 ms for the PI control method and after 1 ms for the SMC. In the second part of the study, a floating mode and PI controller is used to monitor the demand for a balanced series resistor SEPIC converter.

V. SYSTEM FUNCTION

A. BLOCK DIAGRAM

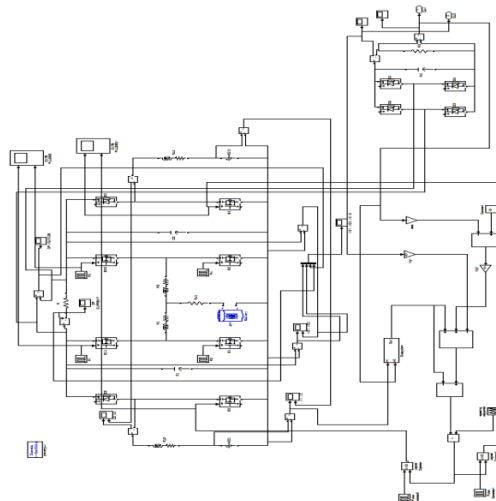


Fig. No.1. Block diagram of simulation setup in MATLAB Simulink

VI. FUNCTION METHOD

In the study, the design of the converter was implemented and applied by determining the values of the elements of the SEPIC converter circuit through the input voltage, power and output voltage of the drive. Kesik E. P. designs SEPIC battery charger hardware for automotive photovoltaic applications. The topology of the SEPIC converter is investigated in detail and all necessary component parameters are calculated using the relevant theoretical equations in accordance with the design objectives. Based on these calculations, the most suitable switching frequency is determined. Subsequently, the SEPIC converter circuit is designed and simulated using the LT circuit simulator. Simulation studies were performed in real time and verified by performing the required experiments. It applies SMC to a SEPIC converter in a discrete-time environment. The state model of the controlled SEPIC converter is obtained using the state space method. The system model required for the controller is then calculated with respect to the small signal model of the transducer. As a result of the performed simulation studies, the robustness of the controller is shown. Khateb A.E. et al. design a fuzzy logic controller (FLC) based on a SEPIC converter for maximum power point tracking (MPPT) of a PV system.

1. SLIDING MODE CONTROL

In control, the sliding mode control or SMC is always the cross section of the system's "sliding" behavior, which changes the dynamics of a non-uniform system using a non-uniform control signal. system. Legal advice of the state is not a permanent responsibility. Instead, it can switch from one connection model to another depending on the current position in the state space. Therefore, sliding type control is a different control method. Many control models are



designed such that trajectories always move to adjacent areas with different control patterns, so the final trajectory is not available in a single control system..

VII.CONVERTERS

1. BOOST CONVERTER STEP-UP COONVERTER

DC-DC converter is a device that accepts DC input voltage and generates DC output voltage. Usually the output is at a different voltage than the input. In addition, DC-DC converters provide sound insulation, power bus cooling, etc. used to provide here is an overview of some popular DC-DC converter topologies. When the transistor is turned on, $V_x = V_{in}$, when it is off, the inductor current passes through the diode making $V_x = V_o$. As shown in Figure 1.2, the voltage across the inductor must have an average value of zero for the average current to be stable.

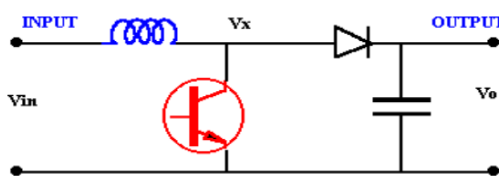


Fig no.2. Boost Converter Circuit

2. BUCK CONVERTER STEP-DOWN CONVERTER

In this circuit, the transistor conduction uses a voltage V_{in} at one end of the inductor. This voltage causes the inductor current to increase. When the transistor is off, current will continue to flow through the inductor, but current will flow through the diode. We start to think that the current through the inductor will never reach zero, so the voltage V_x is now the voltage across the diode to the output time.

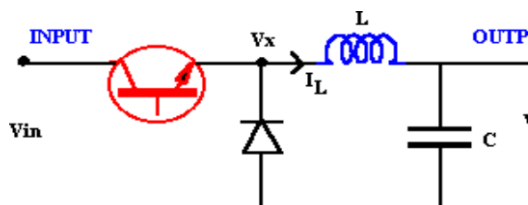


Fig no.3 :Boost Converter Circuit

3.BUCK-BOOST CONVERTER

Buck-boost converter conducts regularly when the transistor is on, $V_x = V_{in}$, and when the transistor is off, $V_x = V_o$. For the period of zero net switching current, the average voltage across the inductor is zero. The Buck, boost, and buck-boost converters all use an inductor to convert energy between input and output, analysis is based on voltage balance across the inductor. . The CUK converter analyzes capacitor-based current measurement using a power converter. The circuit in Figure 1.10 is derived from the DUALITY rule of a buck-boost converter. duality rule of a buck-boost converter.

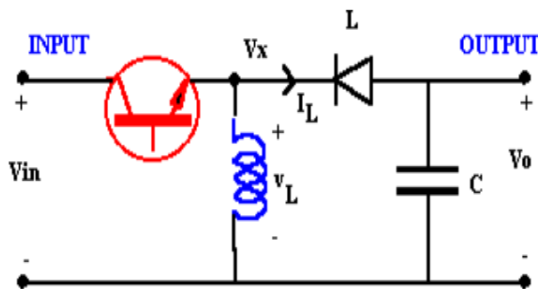


Fig no.4.schematic for buck-boost converter

4. CUK CONVERTER

Buck, boost and buck-boost converters all use an inductor to convert energy between input and output, the focus is on equalizing the voltage across the inductor. The CUK converter analyzes capacitor-based current measurement using a power converter. The circuit in Figure 1.10 Law of Duality from Buck-Boost Converter Assuming that the current from the inductor is basically ripple free, we can control the stability of capacitor C1.

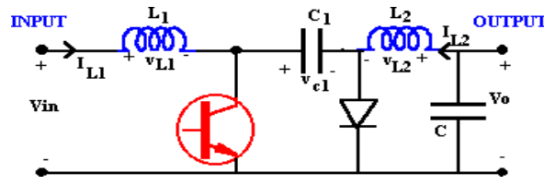


Fig no : 5 CUK Converter

5. Forward Converter

The working problem of the circuit in Figure 1.14 is that only positive voltage is used to the core, hence being flux. Only increases with the given application. When the magnetic flux increases and there are disturbances in the circuit, the magnetic flux will increase until the core is saturated. The generator can only continue to run when there is no significant DC in the input power. When the switch opens, there is a positive voltage across the base and the magnetic flux increases. When the output is dead we need to supply a negative voltage to reset the core flux. The circuit in shows a tertiary winding 41 with a diode connection to allow reverse current flow. Note that the "dot" rule for the tertiary winding is the reverse of that for the other windings. When the circuit is closed, current flows to the "dot" terminal. Core inductance is used to maintain current flow in terminals of the same name.

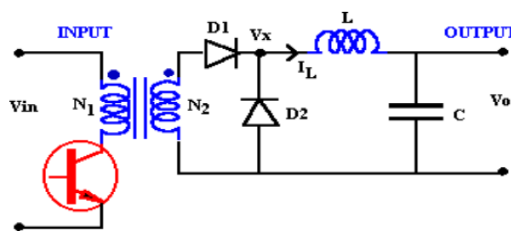


Fig no.6. Forward Converter

6. CONVERTER COMPARISON

The performance ratio of DC-DC converters. Note that only disk converters show the relationship between control (duty cycle) and output voltage. Boost bulb for 50% duty cycle can reduce or increase voltage rating through integration.

7. SOFT-COMMUTATING METHOD FOR AN ISOLATED BOOST CONVERTER

The high power isolated bidirectional dc/dc converter has become an essential part in alternative power. Using the current generator to drive the generator in an isolated step-up converter will result in more current being drawn from the converter compared to an isolated buck converter. This is due to the transformer's leakage inductance. A full bridge dc/dc converter is proposed for high voltage bidirectional applications. It uses two voltage-fed inverters to drive both sides of the transformer, thus eliminating current-fed inverters. Both voltage-fed inverters operate in soft switching mode. A pair of active half-bridge soft-switch bidirectional DC/DC converters with few power components is proposed. It has a voltage-fed inverter on the high-voltage side and a current-fed inverter on the low-voltage side. Both converters use the transformer's leakage inductance as a power converter, allowing power to flow in both directions during the conversion process.

8. CONVENTIONAL METHOD:

A step-up converter (step-up converter) is a power converter with an output voltage greater than the input voltage. A coupled inductor step-up converter is used here as it can be used effectively to reduce the duty cycle and stress on the switches. Paralleling converter power levels is a well-known interleaving technique often used in high current or high power applications to meet the required output power with small power transformers and inductors. An interleaved link-to-inductor step-up converter can be used to exploit the effects of the interaction. In this way, the single inductance boost converter cell is considered as one phase and these phases are connected in parallel and operate at the same

frequency. Also, each phase operates on the same cycle, but phase shifted by $2/n$ radians in electrical angle. It can be said that the effective change seen from the input and output of the interactive converter circuit due to the interaction is n times higher than the switching frequency of the phase.

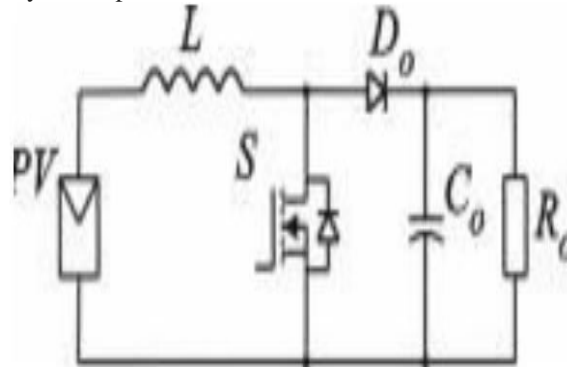


Fig no: 7 Single cell boost converter

9. SIMULATION

MATLAB is an interactive program whose main data is a string that need not be long. This allows to solve many computational problems, especially matrix and vector formulations, in a fraction of the time it takes to write non-interactive scalar programs in languages like Fortran. It is a teaching tool for teaching and learning in a university, mathematics, engineering and science. MATLAB has a number of additional specialized problem-solving tools called toolboxes. Important for most MATLAB users, text boxes allow you to learn and use specific techniques. Areas with tools include signal process, machine control, neural networks, fuzzy logic, wavelets, simulation, etc.

VIII.RESULTS

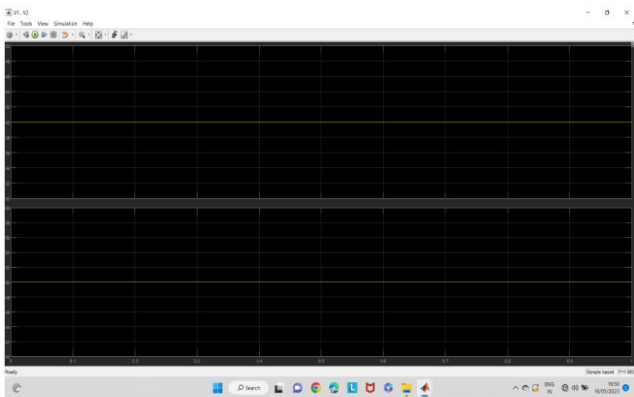


Fig no: 8 Output voltage graph

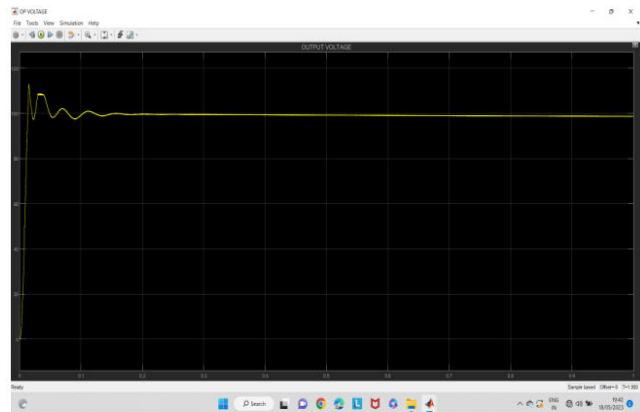


Fig no:9 Output current graph

VIII. CONCLUSION

In this study, the analysis and model of the SEPSIMU converter is the LINK/SEPSIMA converter program. In the first part of the study, the best SEPIC converter was reached by using the floating mode and PI controller. The PI controller was not calculated by trial and error as $K_p = 0.001$ and $K_i = 0.2$. When using the PI control method, the output voltage reaches the reference value after about 0.02 seconds, while the floating type control method follows the reference value after 0.001 seconds. The output voltage error was found to be the lowest after 20 ms for the PI control method and after 1 ms for the SMC. In the second part of this study, floating type and PI controller are used to monitor the demand for equal series resistance SEPIC converter. In the SEPIC converter, which is ideal for comparison, the PI controller is not taken as the same K_p and K_i value. When using the PI control method, the output voltage reaches the reference value after about 0.04 seconds, when using the SMC method, the output voltage follows the reference value

after 0.002 seconds. When the two different situations are compared, it is seen that the output voltage changes and the set time increases for the ESR state. This research can be used to derive new DC voltages by measuring the voltage produced by photovoltaic panels according to the demand of the load. SEPIC converters are more popular than other converters as they have overcurrent limitation, are easier to control than semiconductor switches, and help reduce current ripples by reducing filter requirements.

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